

Researcher's Guide to the Adolescent Brain Cognitive Development (ABCD) Study: Release 3.0

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The Adolescent Brain Cognitive Development (ABCD) Study is the largest long-term study of brain development and child health in the United States. The ABCD Research Consortium consists of a Coordinating Center, a Data Analysis and Informatics Center, and 21 research sites across the country, which have enrolled 11,874 children ages 9-10 in the study. Researchers will track their biological and behavioral development through adolescence into young adulthood. Further information on the study can be found at abcdstudy.org.

Over 1800 researchers around the world have access to the ABCD dataset. This educational course aims to orient this large user base, many of which are part of the human brain mapping community, to the unique opportunities, challenges, and considerations that the ABCD Study affords.

With the release of the first longitudinal dataset in Summer 2020, this half-day educational course will provide important updates from last year's educational course (which detailed the baseline data only), ways of accessing different raw and curated datasets, leveraging new analytical tools to accelerate research, and statistical considerations important in population studies. Updates that will be presented to attendees include behavioral ontologies, mental health assessments, longitudinal imaging data considerations, and the integration of novel technologies, such as data from wearable technologies and geotagged informatics on pollution, socio-economic

factors, and climate change implications. The educational course will close with a panel discussion where attendees will be able to discuss elements of the study with the people who produce and share the data.

Objective

- 1) Recognize the purposes and aims of the ABCD study when developing research questions.
- 2) Distinguish the different ways of accessing and utilizing neuroimaging, demographic, cognitive and health data, and characterize the advantages and limitations of the ABCD dataset when designing, executing and publishing ABCD research.
- 3) Apply the ABCD Data Analysis and Exploration Portal (DEAP) and associated analytical tools and guides to individual research queries.

Target Audience

Researchers of all experience levels who would like to use the ABCD study data for investigations into adolescent brain development, substance abuse, mental health, social and emotional functioning, neurocognition, environmental pollution, activity metrics and genetics. This course also provides information on tools for manipulating raw imaging data for researchers of neuroimaging methodologies, such as image processing and data harmonization.

Presentations

The ABCD Cohort

The Adolescent Brain Cognitive Development (ABCD) Study is the largest long-term study of brain development and child health in the United States. The ABCD Research Consortium consists of a Coordinating Center, a Data Analysis and Informatics Resource Center, and 21 research sites across the country, which have enrolled 11,880 children ages 9-10 in the study. Researchers will track their biological and behavioral development through adolescence into young adulthood. Further information on the study can be found at abcdstudy.org. This presentation will focus on important updates in the study aims, retention strategies, and data collection of the study, which is conducted with collaborators at the U.S. National Institutes of Health (NIH) and other federal partners. Specifically, longitudinal aspects of the study will be emphasized, as well as new workgroups and assessments that have been added in data release 3.0, as compared to previous releases.

Presenter

Terry Jernigan, University of California San Diego La Jolla, CA
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Physical, behavioral and environmental phenotypes

The ABCD Consortium has established standardized and harmonized assessments of neurocognition, physical and mental health, social and emotional functions, and culture and environment. Biospecimen collection for genetic

and epigenetic analyses are also done every other year, and the remaining assessments are conducted semi-annually or annually. This presentation provides an overview of the wealth of available ABCD phenotype data and how to access and analyse this information. Specifically, this section will focus on data ontologies that can aid users in navigating the vast amounts of behavioral phenotypes available.

Presenter

Susan Tapert, University of California San Diego La Jolla, CA
United States

Mental health phenotypes

The sample size and developmental period included in ABCD's study design provide a valuable opportunity to better understand the onset of psychiatric disorders in adolescence. The various measures of mental health phenotypes that are available to ABCD Study data users will be described. Attendees will also be informed of important considerations of the data such as the nature of parent vs child reports about child experience and behavior, and the availability of teacher reports about children and parent-self report. We will describe the trajectory of assessments over time, clarify which assessments are being repeated across waves, describe new assessments that were introduced after the start of the study, and review interpretation across timepoints as children enter adolescence. Issues critical to valid interpretation of the data will be discussed, including how missing data are being handled and information about quality control procedures.

Presenter

Deanna Barch, Ph.D., Washington University
Psychological & Brain Sciences
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Neuroimaging processing pipeline and baseline data

The ABCD Consortium has established multimodal structural and functional brain imaging protocols, collected at two-year intervals. The protocol features structural MRI (T1-weighted and T2-weighted images), diffusion MRI (diffusion tensor imaging (DTI) and restricted spectrum imaging (RSI)), resting-state fMRI and task-based fMRI (emotional n-back, stop signal task, and modified monetary incentive delay). This data is available to the registered collaborators as raw DICOMS, minimally processed files and tabulated curated spreadsheets of parcellations of the brain using FreeSurfer, AtlasTrack among other measures. This session is an overview of the neuroimaging processing pipeline used in ABCD, how to access different types of data and the advantages and limitations of each different format. This presentation will also review the ABCD baseline and follow-up neuroimaging data (included in release 3.0, released Summer 2020), data harmonization requirements, explain why certain data were

excluded, and the important factors investigators should consider when using the ABCD neuroimaging data. Important updates in the image processing pipeline and quality control procedures since release 2.0.1 will be provided. There will also be a discussion regarding the relationship, strengths and weakness between diffusion tensor imaging (DTI) and restricted spectrum imaging (RSI) measures. We will also highlight new processing techniques to be applied in future releases for enhanced QC, motion correction, and between scanner harmonization.

Presenter

Donald Hagler, University of California San Diego La Jolla, CA
United States

Scientific approaches and tools in ABCD - Statistical inference

This session will provide an overview of analytical considerations for working with large population studies. This will be followed by a demonstration of the ABCD Data Analysis and Exploration Portal (DEAP) for accelerating statistical analyses and publication. The focus will be on longitudinal analyses, incorporating the behavior genetic (twin models) and molecular genetic components of ABCD, as well as integrating these with imaging data analysis.

Presenter

Wes Thompson, University of California San Diego La Jolla, CA
United States

Novel technologies: Fitbit, apps, and beyond

Attendees will be introduced to the wealth of data available in the 3.0 release relating to self-reported screen-time activities of the youth (e.g. social media app usage, video gaming) and the application of novel technologies within the ABCD framework. A close examination will be made of the quality and usefulness of data collected from all youth using the Fitbit, including measures of physical activity, heart rate, and sleep stages. Future plans will also be discussed for the potential application of other novel technologies to ABCD, including passive data collection (e.g. from smartphones) and geocoding. Recommendations for mining this data will be provided, as well as examples of how these measures can be integrated in a neuroscientific framework.

Presenter

Fiona Baker, Stanford Research Institute International Menlo Park, CA
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